Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **30 SEP 1997**	2. REPORT TYPE	3. DATES COVERED **00-00-1997 to 00-00-1997**

4. TITLE AND SUBTITLE **Development of an Arctic Low Frequency Ambient Noise Model**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Postgraduate School,Department of Oceanography,Monterey,CA,93943**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

DEVELOPMENT OF AN ARCTIC LOW FREQUENCY AMBIENT NOISE MODEL

Prof. Robert H. Bourke
Prof. James H. Wilson
Department of Oceanography
Naval Postgraduate School
833 Dyer Road, Bldg 232, Rm 328
Monterey, CA 93943-5122
bourke@oc.nps.navy.mil
Voice: 408-656-2673; Fax: 408-656-2712
Award No. N0001497WR30096

LONG TERM GOALS

To develop a low frequency Arctic ambient noise model to predict extreme (loud /quiet) noise events due the presence or absence of storms.

OBJECTIVES

To determine the internal stress of the ice canopy covering the Arctic Ocean due to convergent atmospheric forcing and relate this to energy dissipation rate due to ridge building, the major source of ambient noise in the frequency regime under investigation.

APPROACH

We plan to use the Navy's Polar Ice Prediction System (PIPS) model to determine the ice stress and energy dissipation rate over the ice-covered Arctic Ocean on a daily basis. This model is predominantly driven by atmospheric forcing using the wind fields generated by the Navy's NOGAPS model at FNMOC. We will relate energy dissipation due to intense ice fracture (ridge building) caused by migrating polar storms to ambient noise based on noise data acquired by ice-mounted drifting buoys. The source level density in each one degree latitude/longitude cell will then be propagated back towards one or more randomly placed receivers to estimate the ambient noise level. The modified Ambient Noise Directional Estimating System (ANDES) will be used to calculate the noise field. Drifting buoys or moored or towed array sonars will be used to calibrate the dissipation rate and the source level density estimates.

ACCOMPLISHMENTS

We have completed an empirically-based model to estimate the ambient noise level based on 12-hourly mean wind speeds in one degree latitude/longitude cells. We have contracted with Dr. Bill Hibler, the original developer of the PIPS model, to modify the PIPS code to produce output fields of ice stress and energy dissipation rate. We are working with the National Ice Center (NIC) and the Naval Oceanographic Office (NAVO) to insert a series of drifting buoys in the Arctic Ocean for verification of our model forecasts. We are working with the Alaskan SAR Facility (ASF) to obtain images of the ice cover before, during and after the passage of a storm. These images will be used to establish the number and spatial density of newly created ridges which we assume are directly related to the increase in ambient noise to due to storm forcing.

SCIENTIFIC/TECHNICAL RESULTS

Our empirical model (Collins, 1996) has shown that it is possible to estimate the noise field due to the creation of pressure ridges as a result of convergent forcing by migrating storms. The noise estimates are quite accurate during periods of extreme noise generation, i.e., when many ridges are being created. During periods of moderate forcing, when few ridges, often widely dispersed, are formed, the model estimates are not as consistent. In this latter situation, the noise field is highly azimuthally directional but our noise measurements, upon which we calibrate our model estimates, are omnidirectional. In the same vein, our model estimates are good during extremely quiet periods when the horizontal directionality of the noise field is azimuthally uniform.

IMPACT FOR SYSTEMS APPLICATIONS

This research is in direct support of submarine operations under ice. Great tactical advantage can be achieved if a submarine is forewarned of times and locations of extreme loud or quiet noise events. During loud periods noisy housekeeping operations or high speed runs can be conducted. Conversely, measures can be taken to avoid counterdetection during periods of extreme quiet. The Naval Undersea Warfare Center (NUWC) and Submarine Development Group 12 are interested in field testing and assisting us in calibrating our ambient noise forecast model.

TRANSITIONS

Modification of the Navy's operational ice forecast model (PIPS) to improve its ice deformation physics (rheology) and to provide outputs of ice stress and energy dissipation rate.

RELATED PROJECTS

None

PUBLICATIONS

Collins, D. A., Development of a low frequency ambient noise storm model of the Arctic Ocean, Master's thesis, Naval Postgraduate School, Monterey, CA, 1996.

Wilson, J. H., R. H. Bourke, L. Ehret and D. A. Collins, A low frequency Arctic ambient noise model to estimate extreme noise events, 1996 Fall AGU Meeting, San Francisco, 15-19 Dec 1996. Abstract in: EOS, Trans., Am. Geophys. Un., 77(46), F381, 1996.